Application Form for World Centre of Excellence on Landslide Risk Reduction 2023-2026

1. Name of Organization: CERI - Centre for Research on Prediction, Prevention, and Mitigation of Geological Risks
2. Name of Leader: Gabriele Scarascia Mugnozza (Director of CERI)

   Affiliation: Department of Earth Sciences and CERI – Sapienza Università di Roma

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   Core members of the activities

   Names/Affiliations: (4 individuals maximum)

   Carlo Esposito, Department of Earth Sciences and CERI – Sapienza Università di Roma

   Francesca Bozzano, Department of Earth Sciences and CERI – Sapienza Università di Roma

   Salvatore Martino, Department of Earth Sciences and CERI – Sapienza Università di Roma

   Paolo Mazzanti, Department of Earth Sciences and CERI – Sapienza Università di Roma
3. Date of Submission of Application

April 10th, 2023

4. Activity scale and targeted region.

   1) Global, 2) Intercontinental, 3) Continental, **4) Regional, 5) National**
5. Short Title characterizing past and planned activities (10 words maximum)

From learning on case studies to forecasting scenarios of ground instabilities

6. Objectives for 3 years: (5 lines maximum; what you expect to accomplish?)

In this three-year period, following the experiences gained in previous years, the objective is to guarantee an effective transfer on an operational level (therefore to institutional stakeholders) of advanced methods and techniques for the identification and characterization of landslide processes, the evaluation of their hazard and related risk and, therefore, the correct risk management. All this considering possible chain and/or coupled (multi-hazard) effects especially due to the combination of hydraulic conditions and/or seismic shaking of the slopes

7. Background Justification: (10 lines maximum)

The CERI research centre was estabilished with the specific objective of bringing together the knowledge of researchers from different cultural backgrounds with the aim of facilitating interdisciplinary research lines for a better knowledge of geological processes to favor risk reduction practices and policies. In fact, Italy is a nation

marked by a high level of risk due to natural processes, with particular reference to geological ones. The geo-hydrological risk is of particular impact and is therefore one of the central topics of CERI's activities over the years. In the fields of geo-hazard assessment and related risk reduction several research projects have been granted as well as many research contracts have been signed so far, as also testified by its selection as one of WCoE under the title of "Research and development of advanced technologies for landslide hazard analysis in Italy" in the period 2008–2011. Another relevant activity of CERI is represented by teaching and training addressed to post-graduate students and technicians (mainly geologist and engineers) from public bodies and private companies.

8. Resources available for WCoE activities

   Personnel: 3 Full Professors; 6 Associate Professors; 4 Assistant Professors; 2 Post-doc fellows; 4 PhD students

   Facilities:

   a. Laboratories: Soil mechanics laboratory; GIS and thematic mapping laboratory; Remote sensing laboratory; Quantitative hydrogeology laboratory; Chemistry of fluids laboratory. CERI also manages – together with the Department of Earth Sciences – 2 experimental site laboratories (https://www.dst.uniroma1.it/NaturalePoggioBaldi; https://www.dst.uniroma1.it/strutture/laboratori/LaboratorioNaturaleAcuto) funded by the Italian Ministry of University and devoted to the development and refinement of monitoring techniques for slope stability issues in rock masses.

   b. Equipment: GBInSAR systems (2); Total Robotic Station; Terrestrial Laser Scanner; GPS; Geophysical equipment: 5 Seismic dataloggers; 8 triaxial geophones; 2 triaxial accelerometers; Weather station (pluviometer, thermometer, anemometer, hygrometer); Infrared thermal camera; UAVs: 2 multicopters, 1 fixed-wing; Inclinometer probe; Conventional devices for field investigations on rock masses (sclerometers, point load, Barton profilometer); Phreatimeters and multi-parametric probes for on-site groundwater characterization; Instrumented flume for simulation of shallow landslides induced by rainfall; High performance workstations; High-capacity cluster server; Advanced software for: slope stability analyses, hydrogeological modeling, management and processing of remotely sensed data, geological modeling.

   Budgets: in the last 3 years (2020-2022) the research centre CERI had a budget of about 3.3 M€ from EU funded projects and research collaboration agreements (about 2.5 M€) and other consulting activities for private and public companies (about 1.2 M€)

Affiliation and Contribution to ICL/IPL-GPC: CERI is full member of ICL since 2018 and participates to the Italian Network of ICL, established in November 2018.

9. Description of your past activities related to risk reduction of landslides and other related earth system disasters (30 lines maximum)

To effectively summarize the research activities carried out by CERI and/or the proposed core members for the present WCOE application, we list in the following the main research projects / contracts managed in the frame of ground instabilities issues.

- (2018 – ongoing) Research Project EU H2020-MSCA-RISE-2018. Project title: STABLE Structural Stability STructural stABiLity risk assessment (WP Leader Prof.sa Francesca Bozzano).
- (2021 - 2022) Research contract CERI - LAZIO REGION (administrative district): Liquefaction susceptibility assessment in the whole region's territory (P.I. Prof. Carlo Esposito).
- (2012 – 2022). Grants from the Italian Space Agency (ASI) for the development of the project "MUSAR" - Data Fusion & Smart Automatic Classification of Satellite Multisensor/Multiband SAR and Optical Data" (WP Leader Prof. Francesca Bozzano).
- (2021 – ongoing) Research contract CERI - River Basin Authority of central Apennines: Revision of landslide hazard assessment in some municipalities struck by the 2016-2017 seismic sequence of central Apennines (P.I. Prof. Gabriele Scarascia Mugnozza).
- (2022) Research contract CERI – Municipal Civil Protection of Rome: Preliminary definition of rainfall thresholds for the activation of shallow landslides in earth slopes within the urban area (P.I. Prof. Carlo Esposito).
- (2022 – ongoing) Research Project EU - HORIZON-CL2-2022-HERITAGE-01-08. Project title: TRIQUETRA Toolbox for assessing and mitigating Climate Change risks and natural hazards threatening cultural heritage. (WP Leader Prof. Salvatore Martino).
- (2022 – ongoing) PNRR Infrastructures – Next Generation EU Grants: GeosciencesIR. WP3.1 Landslides. Task: Implementation of an innovative landslide monitoring infrastructure based on photomonitoring technology (P.I. Prof. Paolo Mazzanti)
- (2022 - ongoing) Research contract CERI - LAZIO REGION (administrative district): Monitoring of ground deformations in part of the Lazio Region territory using satellite interferometry (P.I. Prof. Francesca Bozzano).
- (2022 - ongoing) Research contract CERI - LAZIO REGION (administrative district): Update and integration of the geo-hydrological hazard zoning in the whole region's territory (P.I. Prof. Carlo Esposito).

10. Planned future activities /Expected Results: (20 lines maximum; work phases and milestones)

For large scale hazard assessment purposes, the activities will be addressed to:

- Development of techniques for optimizing available databases (landslide inventories), through: i) DTM morphometric analysis, ii) dedicated algorithms for processing satellite SAR data and iii) "data assimilation" processes.
- Refinement of "hybrid" methods (data-driven and physically-based) for the prediction of co-seismic triggering scenarios of landslides, for different saturation conditions of the slopes.
- Quantitative assessment of natural and semi-natural land covers as a function of contrasting geo-hydrological instability

At the slope scale, the activities will consist in continuing and upgrading the management of equipped experimental sites, such as those funded by the Italian Ministry of University and Research and managed by the Department of Earth Sciences, for performing experimental activities on: i) the characterization of equivalent rheology of rock masses, for the refinement of numerical modeling and, thus, failure forecasting, by means of a “multi-physics” monitoring system including thermal, strain and micro-vibrational sensors, ii) the refinement of multi-parametric monitoring of rock cliffs for early warning purposes, by means of an ensemble of innovative and traditional monitoring devices and techniques, especially based on remote sensing.

CERI also intends to promote / support:

- international master’s Degree and/or Joint PhD Programs, with particular focus on the involvement of young scientists coming from developing countries;
- the development of research projects on innovative themes;

11. Beneficiaries of WCoE: (5 lines maximum; who directly benefits from the work?).

Research activities performed and promoted by CERI are strongly addressed to process knowledge and monitoring for risk mitigation purposes. Thus, expected beneficiaries are mainly public authorities in charge of land planning, civil protection and conservation of cultural heritage. Public/private companies managing relevant structures and infrastructures are potential beneficiaries. Finally, young scientists are expected beneficiaries of the proposed teaching/training activities.

12. References: 10 lines maximum, i.e., relevant publications, international/regional/national recognition supporting items 9-10.

- Giannini L.M.; Varone C.; Esposito C.; Marmoni G.M.; Scarascia Mugnozza G.; Schilirò L. (2022). Earthquake-induced reactivation of landslides under variable hydrostatic conditions: evaluation at regional scale and implications for risk assessment. Landslides 19, 2005-2019.

- Martino, S., Fiorucci, M., Marmoni, G.M. et al. Increase in landslide activity after a low-magnitude earthquake as inferred from DInSAR interferometry. Sci Rep 12, 2686 (2022).
- Esposito, C., Di Luzio, E., Baleani, M., Troiani, F., Della Seta, M., Bozzano, F., Mazzanti, P. (2021) Fold architecture predisposing deep-seated gravitational slope deformations within a flysch sequence in the Northern Apennines (Italy), Geomorphology, Volume 380
- Mazzanti, P., Caporossi, P., Brunetti, A. et al. (2021). Short-term geomorphological evolution of the Poggio Baldi landslide upper scarp via 3D change detection. Landslides 18, 2367–2381.
- D'Angiò, D., Fantini, A., Fiorucci, M., Iannucci, R., Lenti, L., Marmoni, G. M., & Martino, S. (2021). Environmental forcings and micro-seismic monitoring in a rock wall prone to fall during the 2018 Buran winter storm. Natural Hazards, 106(3), 2599-2617.
- Delchiaro, M., Mele, E., Della Seta, M., Martino, S., Mazzanti, P., Esposito, C. (2021). Quantitative Investigation of a Mass Rock Creep Deforming Slope Through A-Din SAR and Geomorphometry. In: Vilímek, V., Wang, F., Strom, A., Sassa, K., Bobrowsky, P.T., Takara, K. (eds) Understanding and Reducing Landslide Disaster Risk. WLF 2020. ICL Contribution to Landslide Disaster Risk Reduction. Springer, Cham
- Martino, S., Bourdeau, C., Delgado, J., Lenti, L. (2021). Earthquake-Triggered Landslides and Slope-Seismic Waves Interaction Inferring Induced Displacements. In: Vilímek, V., Wang, F., Strom, A., Sassa, K., Bobrowsky, P.T., Takara, K. (eds) Understanding and Reducing Landslide Disaster Risk. WLF 2020. ICL Contribution to Landslide Disaster Risk Reduction. Springer, Cham.
- Grechi, G., Martino, S. (2021). Multimethodological Study of Non-linear Strain Effects Induced by Thermal Stresses on Jointed Rock Masses. In: Vilímek, V., Wang, F., Strom, A., Sassa, K., Bobrowsky, P.T., Takara, K. (eds) Understanding and Reducing Landslide Disaster Risk. WLF 2020. ICL Contribution to Landslide Disaster Risk Reduction. Springer, Cham.
- Martino, S., Bozzano, F., Caporossi, P. et al. Impact of landslides on transportation routes during the 2016–2017 Central Italy seismic sequence. Landslides 16, 1221–1241 (2019).

13. If your organization is an ongoing WCoE 2020-2023, please attach the articles as pdf files reporting activities of WCoE, IPL project and ICL network published/contributed or a list of planned reports of WCOE 2020-2023 to either journal "Landslides" or/and "P-LRT books."

Please find attached to the transmission email a zip folder containing a selection of publication on IPL/ICL-related journals/books and focused on topics related to WCoE activities and IPL project 237 (2018).